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Anchoring Phenomenon

Objects do not move on their own.



Lesson Concept

Plan and conduct an investigation to observe the cause and effect of objects moving and colliding.

Identified Problem

More goals are made in soccer with a plan.



Standards

Refer to Appendix K.6 for NGSS, CCSS (ELA and Math), and California ELD Standards.

K.6 Collision Goal!



Driving Question

Which plan will move the ball around players?



Storyline Link

In Lesson 5: When Two Objects Collide, students explored the investigative phenomenon “A ball thrown against a wall changes direction” using the game of wall ball. The pattern of pushes in different directions were recorded looking for patterns to use in soccer collisions. This data will be used to solve the problem of planning a strategy for playing the collision game of soccer. (SEP)

In this lesson, the data collected from observing and recording pushes that change direction in Lesson 5: When Two Objects Collide will be used to collaboratively design a solution or strategy for using collisions to move a ball around an obstruction to plan scoring a goal in soccer. Materials available to design or engineer the plan for scoring are familiar materials used throughout the investigations. Materials include a ramp, collision wall, goal, and ball. (SEP) (CCC) (DCI)

Students collaboratively plan, test, adjust their plan, and retest for scoring. This leads to the selection of the best plan or solution. Students use what they have figured out in Lesson 1: Exploration Box about pushes and pulls, combined with designing solutions in Lesson 2: Pullapalooza and strategic use of strength of the force in Lesson 3: Cruising Discs, with the forces of pushes from wind in Lesson 4: Huff, Puff, Move the Ball, and changes due to collisions in Lesson 5: When Two Objects Collide to plan for collisions in the final explanation in this lesson of planning how to move a motionless ball using strength of force and collisions to score a goal in soccer.

An individual plan for scoring will be evaluated based on the student’s understanding of how to get a motionless object (soccer ball) to move in predictable ways using strength of kick (ramp), placement of players for collisions or stopping motion, and direction of kicks to score goals.

Throughout the lesson, a flag (▶) denotes formative assessment opportunities where you may change instruction in response to students’ level of understanding and making sense of phenomena.



Time

130 minutes

Part I	40 minutes	
	10 minutes	Engage I
	30 minutes	Explore I
Part II	30 minutes	
	30 minutes	Explore II
Part III	30 minutes	
	30 minutes	Explain II
Part IV	30 minutes	
	30 minutes	Elaborate/Evaluate

K.6 Collision Goal!



Materials

Whole Class

- FC Barcelona video (<https://www.youtube.com/watch?v=CvblAaEgKjc>)
- Chart paper
- Soccer ball
- 2 cones
- K.6.C1: Class Notebook (continuation of K.1.C1: Class Notebook started in Lesson 1: Exploration Box)

Group (Groups of 2)

- Ruler for a ramp
- 2 blocks to elevate the ruler
- 1 golf ball or rubber ball
- Half of a plastic cup
- 3 sheets of 12" by 18" construction paper
- Heavy wooden block (approx. 3" by 6") or a thick textbook
- 3 bear counters (or any figure that looks like a player)
- Masking tape
- Crayons

Individual

- Pencils
- Crayons
- Science notebook or piece of paper
- K.6.H1: Soccer Field

Teacher

- K.6.R1: Soccer Game Board Set-up
- K.6.R2: Evaluation Rubric For the Summative Sticky Note Plans



Advance Preparation

1. Prepare the Soccer Game Board for every two students following the Soccer Field diagram on **K.6.R1: Soccer Game Board Set-up**.
 - Cut a medium or large plastic cup vertically to make two half cups. Tape the opening down centered at the end of the construction paper to form a cave-like opening to serve as the goal.

K.6 Collision Goal!

- Draw a line on the opposite end of the paper to show where students will place the opening of their ramp.
 - Instead of the pictures of the bears, tape down three bear counters in a line spaced half an inch apart. The line of bears should be about 5 inches in front of the goal.
2. Place ramp materials in a bin so that students can construct a ramp. Include the ball in the bin.
 3. Preview [FC Barcelona](https://www.youtube.com/watch?v=CvblAaEgKjc) video (<https://www.youtube.com/watch?v=CvblAaEgKjc>). Cue the video to a section where you see collisions and then a goal. Showing only 1 to 2 minutes of the video.
 4. Make a copy of **K.6.H1: Soccer Field** for each student.
 5. Prepare the **K.6.C1: Class Notebook** for this lesson as described in the Toolbox for this lesson. Make sure you create 2 notebook pages, one that represents the Soccer Game Board and one called the Soccer Field. Use the **K.6.R1: Soccer Game Board Set-Up** as a model.

TEACHER NOTE

When setting up soccer fields, glue or tape bears in position and tape the goal in place. Students can use different items to represent their teammates (baskets, books, blocks, etc.), and the ramp can be set at different heights.

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Procedure

Part I

Engage I (10 minutes)

Make observations about patterns seen when an object is put in motion.

1. Display the chart of brainstormed questions recorded under: “Questions” started during Lesson 1: Exploration Box in the **Class Notebook**. Ask students to choral read with you all the questions about how to score a goal in soccer. After each question, invite students to share answers to the question and build on their ideas if needed.
2. Show the [FC Barcelona](#) video and ask students to look for how these students moved the ball past the opposing players to make a goal.
3. After viewing the video, ask students to think-pair-share knee-to-knee to answer the question, “How did the players get the ball down the field, past the defenders, and into the goal?”
 - a. Share partner ideas with the group.
 - b. Discuss with the whole group, “What are some of the patterns you noticed?”

TEACHER NOTE

Listen for academic words used to describe the movement when the ball collides with another player, e.g. *push*, *collide*, and *push off*. Expand student explanations by making statements such as “Yes, it hit another player’s head, or we could say it collided with the player’s head.” This supports both California ELD and CCSS in ELA.

Explore I (30 minutes)

Plan and conduct an investigation observing patterns that occur when objects touch or collide.

4. Ask students to talk about how to get the ball around other players to players on their team when they play soccer. Ask students if they have planned where to move the ball or if their coach had a plan to help them move the ball.
5. Show students the Soccer Game Board which you drew on the **K.6.C1: Class Notebook**. Discuss how the diagram is like the way a large soccer field might look. Listen to what students think the model of the soccer game represents.
6. Emphasize that the bears are the opposing team in this Soccer Game Board. The wall represents players from your own team. Have students think about how to get the ball to collide with the wall of players from your team to get around the bears and make a goal.

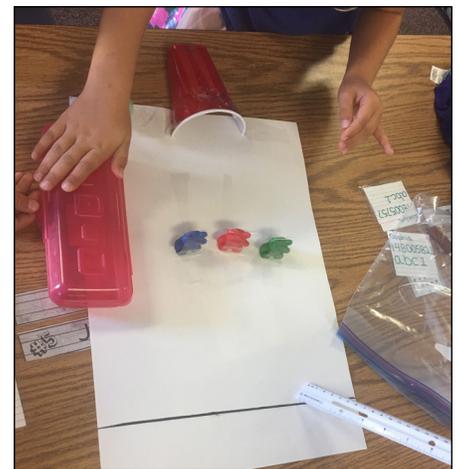


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K.6 Collision Goal!

TEACHER NOTE

Engineering includes objects, tools, and processes. In this lesson, students develop strategies (i.e., processes) to score goals.

7. Distribute the prepared Soccer Game Board, the ball, the ramp, the block, the 3 bears, and the wall. Have students put the goal and the opposing players into position. Then each student works with a partner to draw a plan on the Soccer Game Board.
 - a. Think about where to start the motionless soccer ball using the same kind of ramp used in mini-wall ball with two blocks under the ramp.
 - b. Plans should include the pathway to the goal and the collision with the wall (which represent the students' teammates) to get the ball around the bears and into the goal.
 - c. Ask partners to return to the meeting place with their plans on the construction paper.
8. Display all student plans side-by-side on a ledge and ask partners to explain their plan. Ask students to identify what is the same about the plans and what is different. Have students observe and describe the patterns they see in the plans.
9. If students saw an idea in someone else's plan that they liked, they can revise their plan.

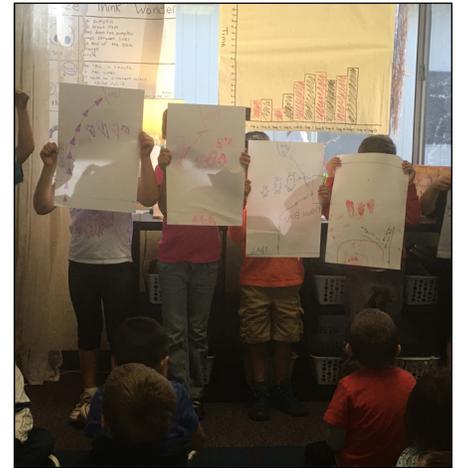


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Part II

Explore II (30 minutes)

Design a solution using patterns of push and pull or collisions to move a soccer ball to the goal.

10. Ask partners to test their plans. After the materials are set up, tell students you must approve the set-up and give the go-ahead to test. Circulate around the room. Remind students to record the path of the ball on the field (the construction paper) using different colored crayons. Partners then discuss what worked and what they would like to try for the next set-up.

K.6 Collision Goal!



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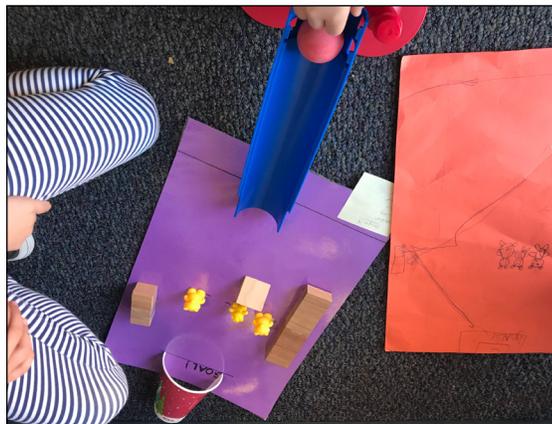


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11. After the initial trial, have partners adjust their models by changing the position of the wall, or the starting point for the ball. After testing, record the pathway using a different-colored crayon. Continue testing until the pathway to the goal is consistent from the starting point, and the ball does not come in contact with the opposing team (the 3 bears).
12. Ask each person to draw a diagram of their final test solution in their kindergarten science notebook or on a sheet of paper. This solution might be quite different than the original plan.
13. Return to the meeting area to discuss the results. Ask partners to explain what they did to get the ball in the goal. How did they figure it out? Have other students ask clarifying questions using the sentence frame: Why did you change ____ to score?
14. Select one or more books from the Literacy Links for a read aloud. Use *How Things Move* if available. Any of the titles can be used to solidify the language of how things move. Discuss main ideas with the class or have the students act out the movements in the book.

Part III

Explain II (30 minutes)

Communicate ideas about the cause and effect of an object in motion colliding with another object.

15. ► Ask partner groups to share their plan and the pathways tried. Each partner group takes turns explaining how they adjusted their set-up multiple times to position the teammates and to determine the start position.

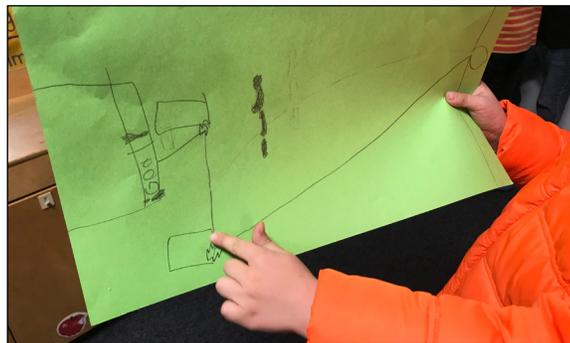


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TEACHER NOTE

Set up the Soccer Game Board in the student choice center for students that need practice seeing the pattern caused by changing the angle of the ramp or the placement of the wall. More proficient students can use word cards placed in the center that label *defenders*, *the wall*, *arrows* to indicate a change in direction. The word cards should be available to every student.

Part IV

Elaborate/Evaluate (30 minutes)

Analyze data and observe patterns of objects colliding to plan a solution to move a soccer ball to make a goal.

TEACHER NOTE

Before this Elaborate/Evaluate, take two of the student plans and make a diagram on chart paper like the one provided on **K.6.R1: Soccer Game Board Set-up**. Have three sticky notes available on the chart. Sticky notes will stand for players from their team. Students will decide where to place the sticky notes.

16. Display a diagram of the soccer field in the **K.6.C1: Class Notebook** and explain that a soccer coach has asked us to do a drill to prepare to make a goal outside on a real soccer field.
17. Notice where the defender bears are on the field. Tell them the coach has already placed one sticky note where he/she wants one teammate to stand. Ask two other students to each place one sticky note where two other teammates should stand to have the best chance of getting the ball from a kicker and directing it into the goal.
18. Take the diagram and the students outside. Set up two cones to make a goal and ask three students to stand in a line just like the bears and three students to stand in the place of the sticky notes on your diagram. Ask three additional students to take turns kicking the ball to one of the teammates to see if it will go in the goal. Keep practicing the drill until all students in the class have a chance to play at least two roles.
19. Return to the room and lead a discussion about how the motionless object (a soccer ball) was put into motion with a push (kick), collided with a player, changed direction, and made a goal. Note that the ball eventually stopped moving.
20. Display the page of the **Class Notebook** with the brainstormed list of games played by students and their families from Lesson 1: Exploration Box. Use choral reading to review the list. Ask partners to discuss knee-to-knee (student-to-student discourse) to identify which games use pushes, pulls, or collisions. Share and record responses using symbols for push, pull, and collision for each game.

K.6 Collision Goal!

21. ► Distribute **K.6.H1: Soccer Field**. Distribute three sticky notes to each student and ask them to place the sticky notes in the best place for teammates to be able to get a ball from the kicker and kick it into the goal. Ask students to include the pathway of the ball and the three sticky notes and mark where the ball starts its movement, collides and changes direction, and makes a pathway to the goal and stops in the goal.

TEACHER NOTE

- Use **K.6.R2: Evaluation Rubric for the Summative Sticky Note Plans** to evaluate the student work on the **K.6.H1: Soccer Field** handout.

Literacy Links

It would be appropriate to have students interact with text to extend their understanding of movement. These selections can be read aloud at any time after this lesson where students have experienced pushes and pulls and change of direction. Suggested books include the following:

Nonfiction:

- *Motion: Push and Pull, Fast and Slow* by Darlene R. Stille and Sheree Boyd
- *Push and Pull* by Robin Nelson
- *Forces Make Things Move* by Kimberley Brubaker Bradley and Paul Meisel
- *Push and Pull* by Patricia J. Murphy
- *Push and Pull* by Hollie J. Endres
- *Give it a Push! Give it a Pull!* by Jennifer Boothroyd
- *Push and Pull* by Lola M. Schaefer
- *Push and Pull* by Charlotte Guillain
- *How Things Move* by Don L. Curry

References

- Boothroyd, J. (2010). *Give It a Push! Give It a Pull!* New York, NY: Lerner Digital.
- Bradley, K. B., & Meisel, P. (2010). *Forces Make Things Move*. New York, NY: HarperCollins.
- Curry, D. L. (2001). *How Things Move*. Mankato, MN: Yellow Umbrella Books.
- Endres, H. J. (2004). *Push and Pull*. Bloomington, MN: Yellow Umbrella Books.
- FC Barcelona. (2016, December 29). LALIGA PROMISES: FC Barcelona (Infantil B) – Real Madrid 2-0. Retrieved from <https://www.youtube.com/watch?v=CvblAaEgKjc>
- Guillain, C. (2012). *Push and Pull*. London: Raintree.
- Murphy, P. J. (2002). *Push and Pull*. New York, NY: Children's Press.
- Nelson, R. (2004). *Push and Pull*. Minneapolis, MN: Lerner Publications.

K.6 Collision Goal!

Schaefer, L. M. (2000). *Push and Pull*. Mankato, MN: Pebble Books.

Stille, D. R., & Boyd, S. (2004). *Motion: Push and Pull, Fast and Slow*. Minneapolis, MN: Picture Window Books.



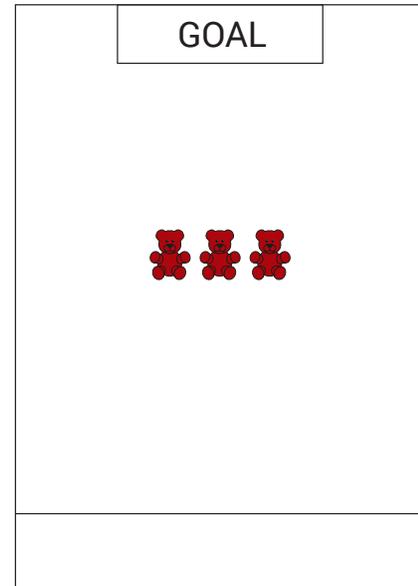
Toolbox Table of Contents

K.6.C1	<u>Class Notebook</u>	K.6.12
K.6.H1	<u>Soccer Field</u>	K.6.13
K.6.R1	<u>Soccer Game Board Set-up</u>	K.6.14
K.6.R2	<u>Evaluation Rubric for the Summative Sticky Note Plans</u>	K.6.15

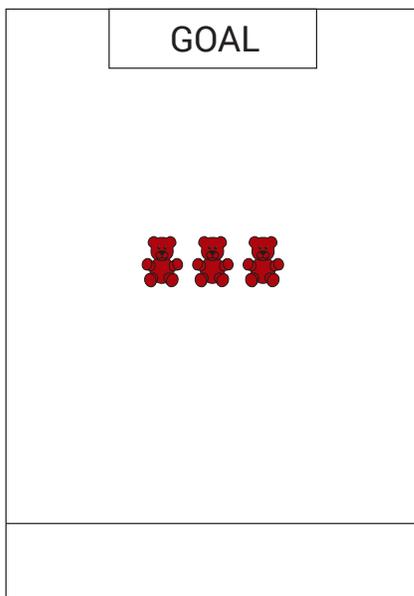
Class Notebook (continuation from Lesson 1)

What are some of the patterns you noticed?

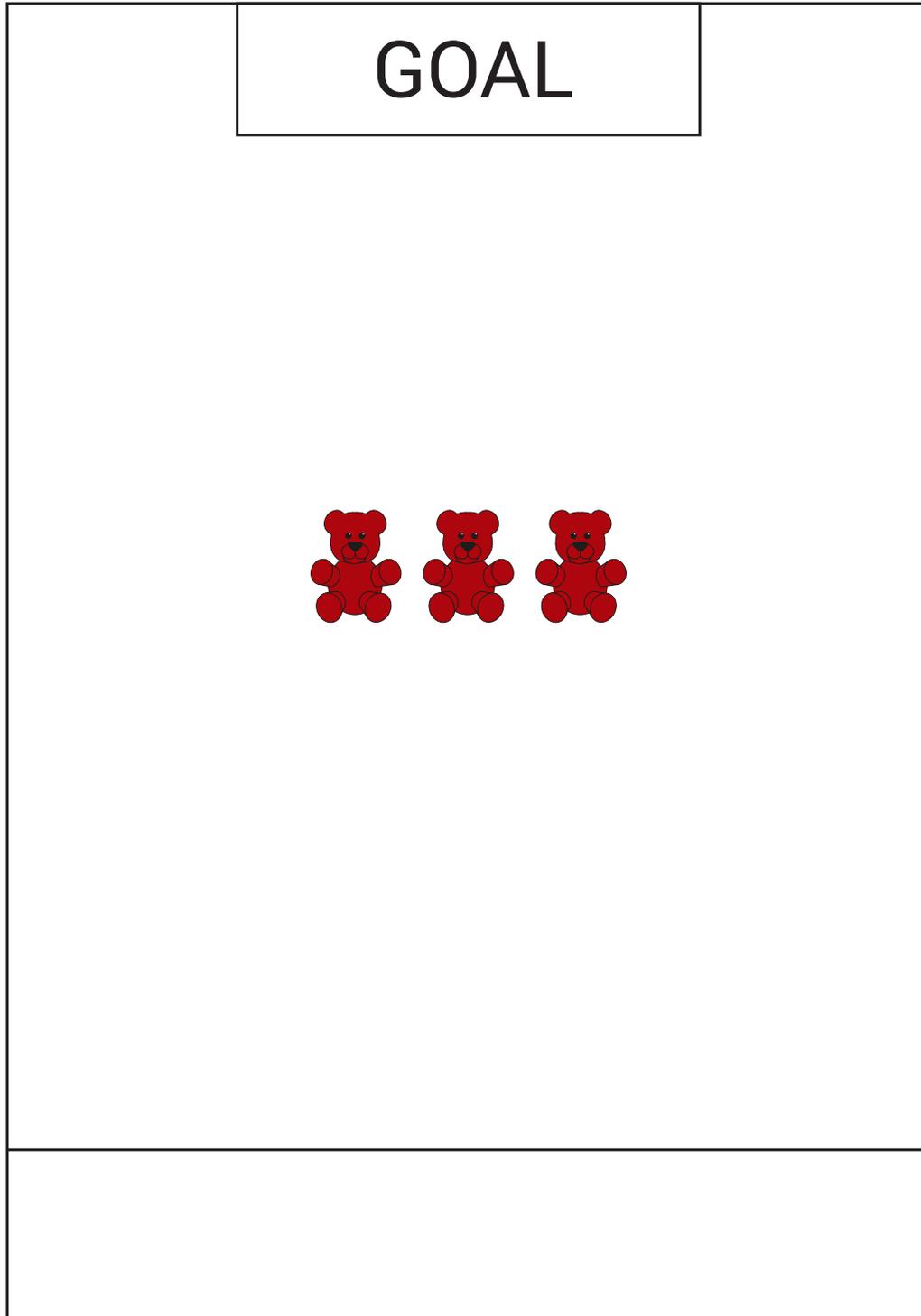
Soccer Game Board



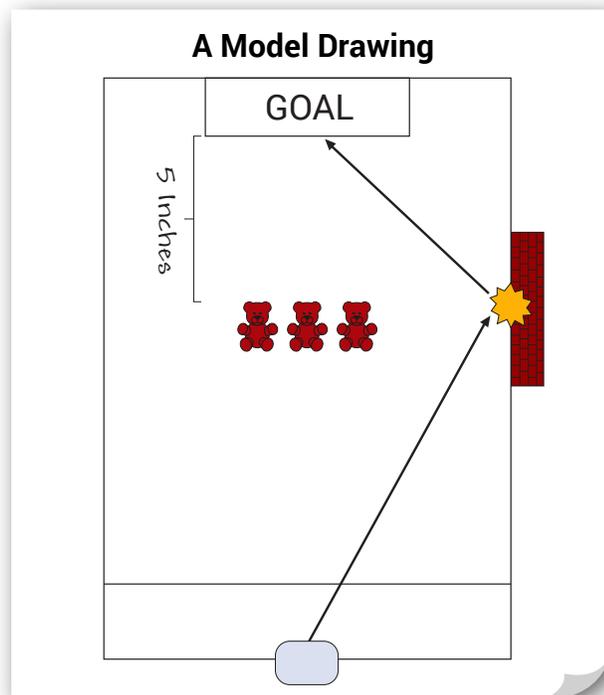
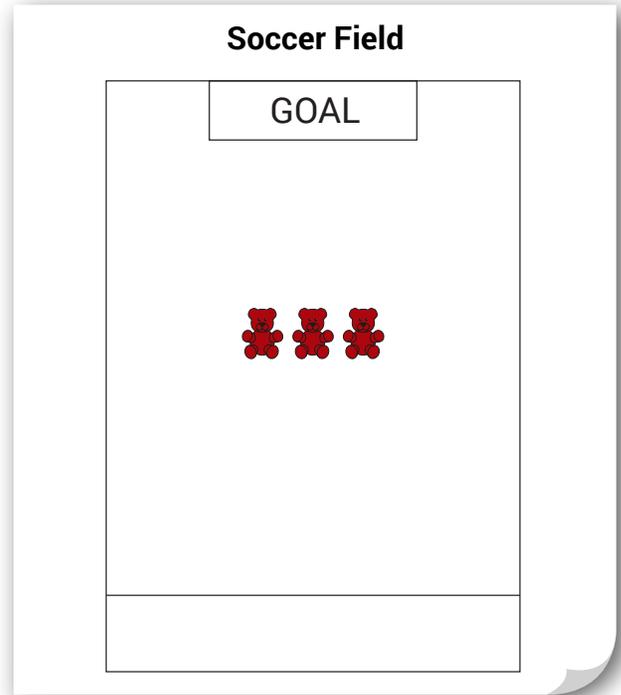
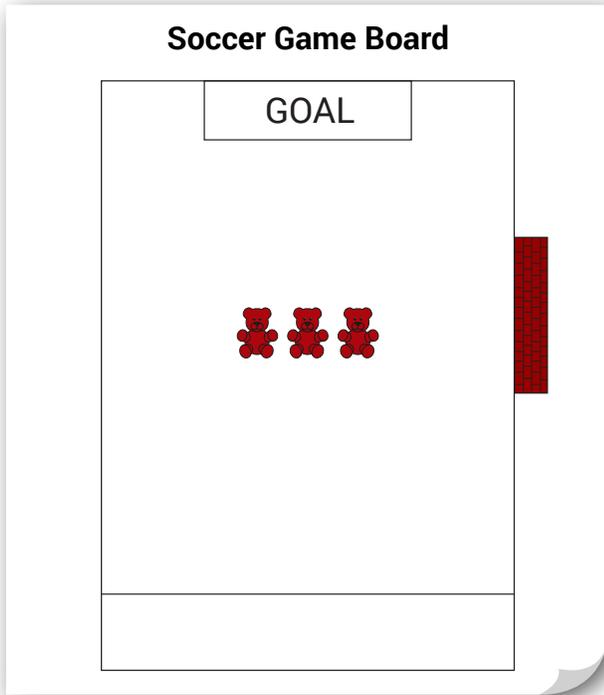
Soccer Field



Soccer Field



Soccer Game Board Set-up



Evaluation Rubric for the Summative Sticky Note Plans

4	3	2	1
Includes all major parts of the system (sticky note players appropriately placed, pathway shows beginning of the kick, collision point, goal, and stopping point).	Includes all major parts of the system (sticky note players appropriately placed, pathway shows beginning of the kick, goal, and stopping point).	Includes some of the major parts of the system (sticky note players appropriately placed, pathway shows goal).	Includes parts of the system but not enough to clearly show a planned pathway.
Includes collision points, arrows showing change of direction and stopping point.	Misses one or more of the following: starting point, collision point, ending or stopping point, and the pathway between the points.	Misses two or more of the following: starting point, collision point, ending or stopping point, or pathway.	Off-topic plan with direction arrows that are not showing direction or change in direction correctly.
Clear arrows show pathway direction.	Arrows are included that show direction of the pathway.	Does not include arrows showing direction or shows an inaccurate path.	

Appendix K.6

Collision Goal!

Next Generation Science Standards (NGSS)

This lesson is building toward:

PERFORMANCE EXPECTATIONS (PE)	
K-PS2-1	Plan and conduct an investigation to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object. <i>[Clarification Statement: Examples of pushes or pulls could include a string attached to an object being pulled, a person pushing an object, a person stopping a rolling ball, and two objects colliding and pushing on each other.] [Assessment Boundary: Assessment is limited to different relative strengths or different directions, but not both at the same time. Assessment does not include non-contact pushes or pulls such as those produced by magnets.]</i>
K-PS2-2	Analyze data to determine if a design solution works as intended to change the speed or direction of an object with a push or a pull.* <i>[Clarification Statement: Examples of problems requiring a solution could include having a marble or other object move a certain distance, follow a particular path, and knock down other objects. Examples of solutions could include tools such as a ramp to increase the speed of the object and a structure that would cause an object such as a marble or ball to turn.] [Assessment Boundary: Assessment does not include friction as a mechanism for change in speed.]</i>

NGSS Lead States. 2013. Next Generation Science Standards: For States, By States. Washington, DC: The National Academies Press.

SCIENCE AND ENGINEERING PRACTICES (SEP)
Planning and Carrying Out an Investigation
<ul style="list-style-type: none">• With guidance, plan and conduct an investigation in collaboration with peers.• Make observations (firsthand or from media) and/or measurements of a proposed tool or solution to determine if it solves a problem or meets a goal.
Constructing Explanations and Designing Solutions
<ul style="list-style-type: none">• Use tools and/or materials to design and/or build a device that solves a specific problem or a solution to a specific problem.
Analyzing and Interpreting Data
<ul style="list-style-type: none">• Use and share pictures, drawings, and/or other writings of observations.• Analyze data from tests of an object or tool to determine if it works as intended.
Obtaining, Evaluating, and Communicating Information
<ul style="list-style-type: none">• Communicate information or design ideas and/or solutions with others in oral and/or written forms using models, drawings, writing, or numbers that provide detail about scientific ideas, practices, and/or design ideas.• Obtain information using various texts, text features (e.g., heading, tables of contents, glossaries, electronic menus, icons) and other media that will be useful in answering a scientific question and/or supporting a scientific claim.

Appendix K.6

DISCIPLINARY CORE IDEAS (DCI)

PS2.A Forces and Motion

- Pushes and pulls can have different strengths and directions.
- Pushing or pulling on an object can change the speed or direction of its motion and can start or stop it.

PS2.B Types of Interactions

- When objects touch or collide, they push on one another and can change motion.

ETS1.A: Defining and Delimiting an Engineering Problem

- A situation that people want to change or create can be approached as a problem to be solved through engineering. Such problems may have many acceptable solutions.

ETS1.B: Developing Possible Solution

- Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people.

CROSCUTTING CONCEPTS (CCC)

Cause and Effect

- Events have causes that generate observable patterns.

Patterns

- Patterns in the natural and human designed world can be observed, used to describe phenomena, and used as evidence.

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Common Core State Standards (CCSS)

CCSS ELA READING

CCSS.ELA-LITERACY.R1.K.1

With prompting and support, ask and answer questions about key details in a text.

CCSS SPEAKING AND LISTENING

CCSS.ELA-LITERACY.SL.K.3

Ask and answer questions in order to seek help, get information, or clarify something that is not understood.

MATH PRACTICES

CCSS.Math.MP2

Reason abstractly and quantitatively.

Appendix K.6

MATH MEASUREMENT AND DATA

CCSS.Math.K.MD.A.1

Describe measurable attributes of objects, such as length or weight. Describe several measurable attributes of a single object.

CCSS.Math.K.MD.A.2

Directly compare two objects with a measurable attribute in common, to see which object has “more of”/“less of” the attribute, and describe the difference.

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California English Language Development (ELD) Standards

CA ELD

Part I.K.1 Exchanging information and ideas via oral communication and conversations

EMERGING

P1.K.1 Contribute to conversations and express ideas by asking and answering *yes-no* and *wh-* questions and responding using gestures, words, and simple phrases.

EXPANDING

P1.K.1 Contribute to class, group, and partner discussions by listening attentively, following turn-taking rules, and asking and answering questions.

BRIDGING

P1.K.1 Contribute to class, group, and partner discussions by listening attentively, following turn-taking rules, and asking and answering questions.

In addition to the standard above, you may find that you touch on the following standards in this lesson as well:

P1.K.2 Interacting with written English (print and multimedia)

P1.K.5 Listening actively and asking or answering questions about what was heard

P1.K.12 Selecting and applying varied and precise vocabulary and other language resources

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